

No 114

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A N

E S S A Y

O N

THE ART OF MAKING
MOSCOVADO SUGAR

W H E R E I N

A New PROCESS is Proposed.

By *J. P. Baker.*

*Verum enim vero; is demum mihi vivere atque frui anima
videtur, qui aliquo negotio intentus, præclari Facinoris,
aut Artis bonæ famam querit.*

SALLUST;

J A M A I C A:

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Bought with the Bequest of the
Hon. Wm. Prescott, of Buxton.

T O
THE HONOURABLE
COLONEL THOMAS FRENCH.

*One of the Judges of the Supreme Court
of Judicature in the Island of Jamaica.
A Judge of the Court of Assize for the
County of Surry. Custos of Kingston
and Major General of the Militia in that
Island.*

T H I S E S S A Y

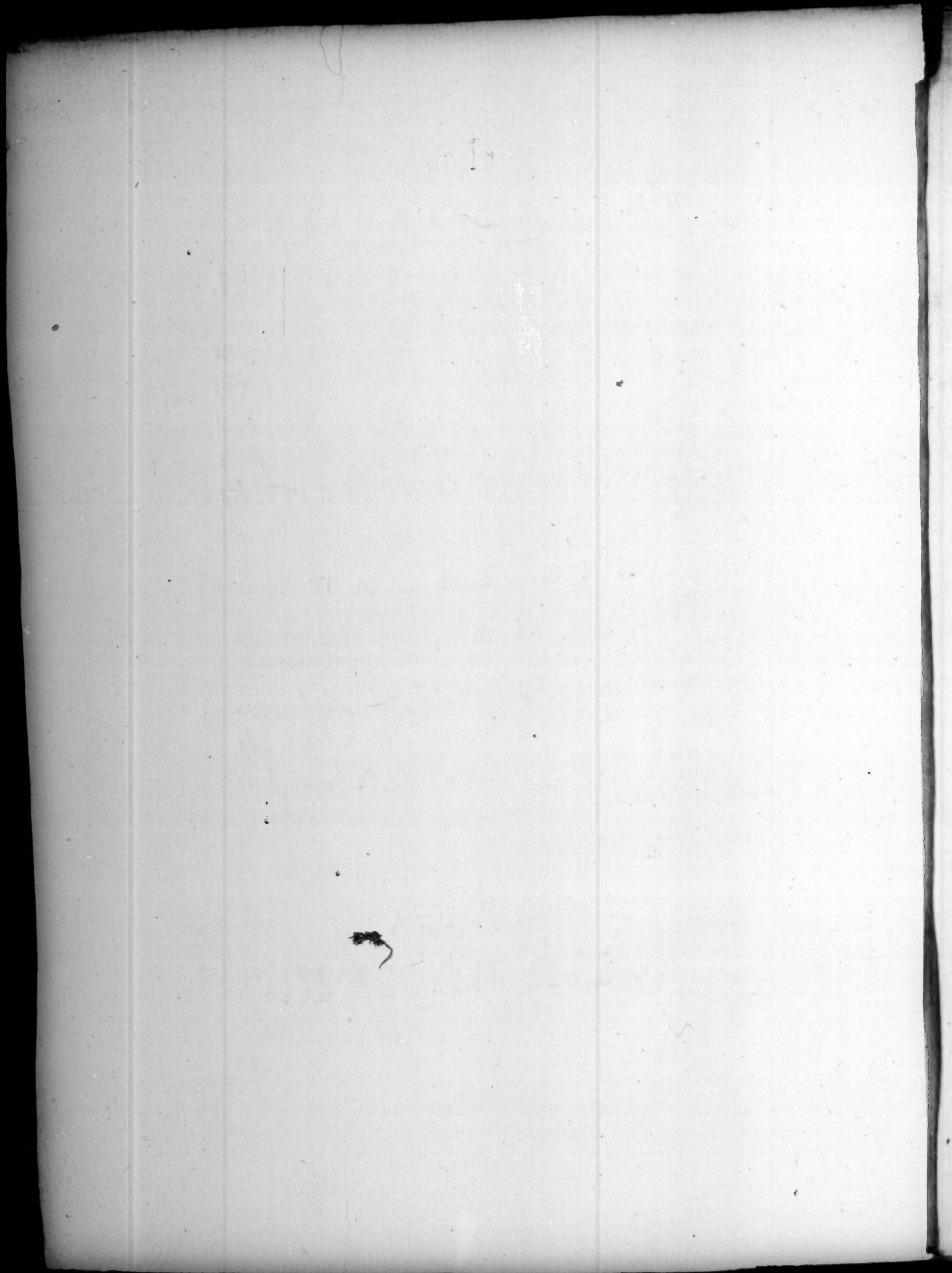
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*Presented and Dedicated in Acknow-
ledgement of the Obligation, by which his
early Protection and Patronage, have for
ever bound his*

most

Humble Servant,

I. P. BAKER.



T H E

P R E F A C E.

Notwithstanding our Reverence for Antiquity, it must be admitted, that natural Knowledge was confined within very narrow Bounds, till the Beginning of the present Century. The System of Philosophy invented and perfected by that great Expounder of the Laws of Nature, Sir *Isaac Newton*, immediately upon its Promulgation, drew the Line between Darknefs and Light. Upon the broad Foundation which he has laid, every Improvement in Science must, in all Probability, be for ever built: The Laws of Gravitation and Attraction were no sooner understood in general, than the most rapid Advances were made towards the Perfection of the particular Theories on which the useful Arts were grounded. It may easily be conceived, that the respective Theories being once settled on a solid Basis, practical Discoveries and Inventions followed of Course.

It will not then be wonderful, that many of the Discoveries and Improvements in the Arts and Sciences so lately originated, should not have yet arrived to this Island; still less are we to be surprized, if we are defective, in improving upon philosophical Principles, such Arts as are only practised in these Climates. The general Inferiority of our Coffee to that of Turkey, and of our Indigo to that of Hispaniola,

to say nothing of the present Subject, are striking Proofs of the Fact; and we must either acquire a Spirit of Improvement, or be content to stand where we are. If other Colonies should not be so content, I fear we shall severely feel how true it is, that *non Progedi est Regredi.*

Of all the Sciences, Chemistry is of the greatest Importance to every Art or Manufacture that does not immediately depend upon Mechanics. If the Dyer, the Brewer and the Distiller, are obviously Chemists; the Baker, the Tanner and the Confectioner, and even the Cook, will, upon Examination, be found to execute their Trades on chemical Principles. It is true, they are no more conscious of this, than a Labourer who pumps Water is, that he is working an hydraulic Machine.

It is not to be expected, that Chemistry, as a Science, will ever find its Way to some of the Gentry above instanced; it will be sufficient, that the Information of others should gradually mend their Practice: But in Proportion as any one of them, by Accident or Instruction, acquires a Knowledge of chemical Truths, he will become more expert in the Exercise of his Trade.

But, where the *staple* Interests of a Community are concerned, it becomes a very different Case. That Sugar is the *Staple* of *Jamaica*, is certain; it is not less certain, that the Business of making Sugar depends on Principles, that are to be acquired only, by the Study of Chemistry; and I fear it is not less certain, that those Principles are unknown to the Generality of our white Inhabitants concerned in the *Staple*: I
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The P R E F A C E.

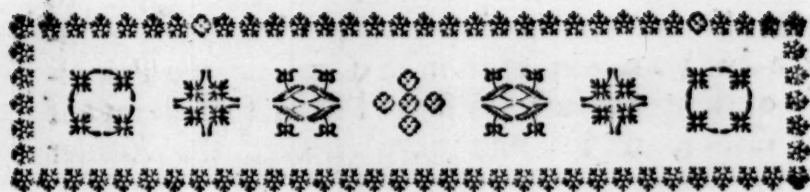
iii.

need not add, that they are universally unknown to the Negro Sugar-boiler. Will it then be less certain, that extending the Knowledge of Chemistry, and diffusing its Principles, will be a Means of improving our Sugar, and be the Occasion of Discoveries, not yet, even thought of.

This Work is given to the Public on these Ideas: The Execution of it has been the more difficult to the Author, because he has attempted to write not only for the Planter, whom we are to suppose a Gentleman of a liberal Education, but for the Overseer and Book-keeper; from hence, the superfluous Explanations of plain Definitions and ill-chosen Examples, because they were familiar. These, and some other Objections even to the Plan, the Author knows not how to remedy, without giving up this main Design of rendering chemical Ideas familiar to those who are concerned in the Management of Sugar Estates: For the rest, he means no more by this Publication, than to convey general Conceptions; to inculcate the Necessity of considering the Subject he lays before his Reader, in a chemical Light; and lastly, to incite others to improve the general Stock of Knowledge, to which he is conscious he is adding but little. May he venture to censure one Body of Men, with whose Profession not only Chemistry, but Science in general is connected, for having compelled the Public to accept this imperfect Performance, by not performing the Task themselves: He means the Professors of Medicine in this Island; and more particularly those, who from their Residence on Estates, whether their own Property or that of others, have had Opportu-

nities of making Experiments, the true Fountains of Knowledge. He will affirm, they will find it more difficult to excuse themselves; as he is assured of the great Abilities many of them indisputably possess.

A wide Field of Improvement, as well in the Agriculture and Distillery peculiar to this Country, as in the Management of its Productions, is open. The Author does not build the Hopes of Reputation on what he has himself done: But if this Example shall prove an Incitement to others; if, in future, the Powers and Labors of other Gentlemen, shall improve the Cultivation and Manufacture of the Produce of Jamaica; he will claim the Merit of every such Author, and say, with *Ulysses*, *Ergo Opera illius mea sunt.*



A N

E S S A Y,

ON THE ART OF MAKING

MOSCOVADO-SUGAR;

W H E R E I N

A NEW PROCESS is proposed.

 UGAR is the essential or peculiar Salt of the Sugar-Cane.

The Art of making Sugar, is therefore the Art of obtaining this Substance from that Plant.

The Art of making Moscovado-Sugar, is the Art of obtaining this Substance in a particular Form.

From these Definitions, it is obvious that making Sugar is a chemical Process.

A

This

This Process cannot be rendered intelligible to those who are unacquainted with Chemistry, without a previous Explanation of some of the Principles of that Science. I should have spared myself that Labor, if I could have referred the Reader to any Book, in which he might find those Subjects I would wish him to comprehend treated of separately. To have referred him to the best Manuals, would have been in vain, unless I could have hit on a Method of pointing his Attention to particular Parts of them: I shall content myself with explaining such Terms in Chemistry as, in their Explanation, necessarily involve the Principles in that Science the Sugar-maker should be acquainted with; and giving a general View of the Substances he may have Occasion either to make Use of, or to separate from his Subject. In doing this, I do not pretend to the Accuracy of a Chemist; but will, nevertheless, avoid laying down any Positions by which the Reader may be misled.

CHEMISTRY itself then, is the Art of separating and uniting the various Principles of which Substances are compounded.

From the first Part of this Definition we are to understand, that by the Powers of Chemistry we are enabled to examine the component Parts of any Subject; and from thence to form a Judgment of the Uses to which it may be applied, whether in Arts, Manufactures, or Medicine. By the latter Part, we understand that Chemistry teaches us to form new Compositions, that do not exist in Nature; from hence it will be easily conceived, that
many

many of those now used in common Life, are the Offspring of this noble Science : Of this Soap, Gunpowder, and many others, may serve as Instances.

Chemists have discovered that all Bodies are compounded of four Principles, called Elements. They are, Fire, Air, Water and Earth. The first two of these, in their elementary State, are liquid ; the last two solid. When they become Parts of Bodies, they are all of them sometimes liquid, and sometimes solid, according to the Manner in which they are combined. Fire and Air, in a combined State, are called, the one Phlogiston, the other fixed Air : We should add, that by the Word Body is understood any Substance, whether solid, liquid, or fluid.

Any two of these Elements being united, form a compound Body.

By Union, the Chemists understand such an intimate Blending or Cohesion of the Particles of a Compound, as to form a new Body or Substance. If the Particles are less intimately connected, they are said only to be mixed : Thus, Vinegar and Water may be united ; Vinegar and Oil can only be mixed.

If two of these Elements are compounded in a given Proportion, and the same two are compounded in another Proportion, very different Substances will be the Results ; and if these two Substances are presented to each other, as they will form a new Combination of Proportions, they will form a new Substance.

The more compounded Bodies are, the nearer their Union approaches to the Nature of Mixture ; the

less compounded they are, the more firmly are they united.

Simple is the opposite Term to Compound.

Those Bodies which to common Observation appear simple, are often exceedingly, always considerably compounded. Dr. Ratty has shewn, that Rain Water itself, is only comparatively pure. Spring Waters are always mixed, generally compounded with Salts and Earths. The Difference of Soils arises from the different Combinations and Mixtures of Matters foreign to Earth; and so of the rest.

The Power by which Bodies are capable of uniting, depends on certain Laws of Attraction, not yet investigated; the having that Power is called AFFINITY.

The Doctrine of AFFINITIES, at least in Conjunction with that of Gravitation, comprehends the whole Science of Chemistry, perhaps of all Nature. I will lay before the Reader such of the Laws of Affinity as are necessary for our Purpose.

1. When two Bodies composed of the same Principles are presented to each other, they will unite.

2. The more simple and similar the Compounds presented are, the stronger their Affinity.

3. As soon as two Bodies are united, they form a new Compound, with new Properties.

4. If two compound Bodies are presented to each other, that have only one similar Principle, they will sometimes unite, and sometimes not, according to the Abundance of the Principles that have no Affinity. Sugar has an Affinity with Water; it will therefore dissolve

dissolve in it, and unite with it. Oil has no Affinity with Water, and but little with Sugar; therefore, if you dip a Lump of Sugar in Oil, and then put it in Water, the abundant Oil will prevent the immediate Action of the Water and Sugar on each other, and retard the Dissolution of the Sugar.

5. If to two Compounds having no Affinity, a Third is presented, that has an Affinity to both, they will all unite or not, as in the fourth Law, according to their Proportions. Oil and Water have no Affinity; Mucilaginous Gums have an Affinity with both, but not so great a One with the Oil, as with the Water: Therefore, if they are put together, they will unite, but not perfectly: They unite, because the Gum has an Affinity with both; but not perfectly, because the Affinity between the Gum and the Oil, is not so great as between the Gum and the Water,

6. If a Substance is composed of two other Substances, and a third Substance is presented, which has no Affinity with one of them, and has a greater Affinity with the other of the two, than they had with each other; the two first Substances will be decomposed, and that which had the Affinity with the third Substance, will be united with it, and form a new Compound.

As the thorough understanding the last of these Laws is of the greatest Importance, I must intreat a particular Attention to the Examples, given by Way of Illustration. I would even advise every Reader, to whom these Doctrines are new, to put them in Practice; the Process I propose depending entirely upon it.

1. Put a Quarter of an Ounce of brown Rosin into an Ounce of rectified Spirit of Wine: Let it stand, 'till the Rosin is dissolved. Pour this Solution into a two-ounce Phial; fill a large Tumbler with Water, to within a little of the Brim; drop your Solution, by single Drops, into the Water.

The Rosin and the Spirit, having an Affinity, unite; and comparing the Experiment with the Law, they form a Substance, composed of two Others: The Water is the third Substance. The instant the Drop touches the Water, the Spirit *quits* the Rosin, and *unites* with the Water. The Rosin, as you drop in the Solution, rises to the Top; and, if collected and dried, is perfect Rosin again.

2. Castile and Almond Soaps are made of alkaline Salt and Oil---of the Olive and Almond. Dissolve a Quarter of an Ounce of either of these Soaps in an Ounce and a Half of Water; drop, by single Drops, Oil of Vitriol into this Solution, and the alkaline Salt will quit the Oil, and unite with the vitriolic Acid. The Oil will swim at the Top: Skim it off, and add more Oil of Vitriol, 'till all Commotion ceases on the Addition; put it by, in a cool Place, and the neutral Salt, formed by the Acid and Alkali, will chrySTALLISE at the Bottom of the Glass. *See this accounted for, in the Observations on Salt.*

3. Green Vitriol or Salt of Steel, are the same Substance: They are composed of the vitriolic Acid, and Iron deprived of its Phlogiston. Dissolve a Dram, or Half a Quarter of an Ounce of green Vitriol, in a Quarter of a Pint of Water, in which you have dropped two Drops of Oil of Vitriol. You have

have now two Substances again: The Iron One; and the Water; the two Drops of Oil of Vitriol, and the vitriolic Acid in the green Vitriol, as it is called, are also but One; more Water, making it a weaker vitriolic Acid; less Water, a stronger One. Drop, by single Drops, a Solution composed of a Quarter of an Ounce of Salt of Wormwood in an Ounce of Water, and the Iron and vitriolic Acid will be decomposed, and the first will fall to the Bottom. This is called being precipitated. (*See PRECIPITATION.*) The Precipitate of the Iron, (if you tried this Experiment on a Scale large enough) being fused or melted, with four Times its Weight of Charcoal Dust, would become perfect Iron again.

In the first of these three Experiments, you will see the Nature of elective Attraction more perfectly, than perhaps in any other; and it is not attended with any Danger. All Experiments with Vitriol concentrated, require Caution; the Oil of Vitriol, itself, burning almost every Thing it touches; and if you hastily pour the Oil of Vitriol into the Solution of Soap, it might even blow up. *You will perceive the Reasons for this Caution, in trying the Experiments.*

To what has been said on the Doctrine of AFFINITIES, I shall add, by Way of Observation, that Fire, in many Cases, increases and diminishes *Affinities*, and sometimes even destroys them: Triture always appears to increase them, and sometimes actually does so, by the Heat arising from Friction.

We must now view Substances in another Light.

All Bodies are either fixed or volatile. When a Body or Substance, upon being heated, expands into

Vapour or Smoke, it necessarily becomes lighter than Air, rises out of the Vessel that contained it, and flies off. Bodies that Fire has this Effect upon, are said to be volatile. Bodies that no common Degree of Fire can volatilise, are said to be fixed.

If two or more Substances are put over a Fire in the same Vessel, and the Heat is gradually increased; the most volatile will rise, and fly off first. E. G. Rum and Water; the Rum will rise first.

As a compound Substance partakes of the Properties of all its Components, if a fixed Substance is united with a volatile One, the whole Compound will become volatile, to a certain Degree: But we are not to confound this with the Case of a volatile Body being only mixed with a fixed One; for there the Whole of the volatile Body will rise, and the fixed One will remain.

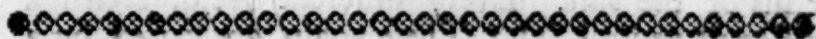
In this Place, it may not be amiss to explain what is meant by *Specific Gravity*. Gravity itself, is a Disposition that all Bodies have to press towards the Center of the Earth, in common Language downwards. Specific Gravity is the Degree of that Disposition which any particular Substance has, in Comparison with all others: This is always in Proportion to the Sum of the Density and Bulk of the Substance. To measure this, some Standard must be taken. Water is that Body which Philosophers have chosen for this Purpose. I should not have touched on this Subject, but for the Purpose of laying down one Law of Gravitation; which is, that,

If a solid Body be thrown into a liquid One, and the solid Body is specifically heavier than the liquid,

liquid, it will sink to the Bottom; if specifically lighter, the solid will swim: Therefore, if I throw a Bullet of an Inch Diameter into a Tub of Water, the Bullet will sink. But if I throw a wooden Ball, of exactly the same Size and Shape with the Bullet, into the Water, it will swim; because the Bullet is heavier than a Quantity of Water of the same Bulk, and the Wood is lighter. Liquids obey the same Law. But this is seldom so obvious in Practice; because two Liquids have generally so great an Affinity as to mix, if not to unite. Gross Oils, indeed, shew the Experiment with aqueous Mixtures, as Solids do with Liquids.

Specific Gravity appears to me to have a greater Connexion with the Doctrine of Affinities, than any Chemist I have met with seems aware of.

The above short View of the Principles of Chemistry, will convey sufficient Ideas of them for our Purpose. I shall now lay before the Reader some Observations on Salt, and some other Substances.



OF SALT.

SALT is supposed to be an exceedingly intimate Union of elementary Earth and Water. Of all saline Substances, Acids are said to be the most simple. Solidity is also said to be their natural Form; but that, from their extreme Affinity with Water, they

they attract so much of it from the Atmosphere, as to be always found in a fluid State. Some of the acid Salts, or simply Acids, are procurable by evaporating the superfluous Water, in a solid Form; others are incapable of such a Concentration. I take the icy Oil of Vitriol to be an Instance of the first, and Vinegar of the last.

If to an Acid an Alkali or an absorbent Earth is presented, they will form a Compound, called a *neutral Salt*. I will instance a few of the most known. If to Aqua-fortis, which is a Preparation of the nitrous Acid, you add Pot-Ash, Pearl-Ash, Salt of Wormwood, or Salt of Tartar, which are all vegetable fixed Alkalies, common Nitre, or *Saltpetre*, will be the Result: Spirit of Vitriol, with these alkaline Bases, forms the vitriolated Tartar of the Shops: The Spirit of Vitriol, with a peculiar absorbent Earth, forms Allum: And, lastly, the Acid of Sea Salt, with a Kind of Alkali, called the Fossil Alkali, makes the Salt we use at the Table.

This Addition of an Alkali or Earth, is called the *Base* of the Salt. Every different Acid, forms a different neutral Salt: These again, are varied by a different Base; and infinite Variations are the Results, if some other Principle happens to be united with them. The vegetable Acids are seldom without Mucilage, Oil, or both. From the Whole then, of what has been here said, we are to collect, that all that we commonly call Salts, are NEUTRAL SALTS; and that they consist of Earth and Acids, or Alkalies and Acids.

ALKALIS,

ALKALIS, or Alkaline Salts, are themselves a Species of Neutral Salts, as they are said to contain Earth and Acid: But here the Earth is abundant, and the Proportion of Acid exceedingly small: The smaller the Quantity of Acid; the stronger the Alkali, the more Acid they contain, the nearer they approach the Nature of what is commonly meant by Neutral Salts.

ALKALIS are divided into volatile and fixed. The first are obtained by Distillation of animal Matters, under certain Circumstances; for Instance, Hartshorn. As these have never been used as a Basis for Neutral Salts, except for medicinal Purposes; we shall consider them no farther. Fixed Alkaline Salts are again divided into Fossil and Vegetable. The Fossil Alkali is generally obtained from Marine-Plants and Weeds: By burning them, and lixiviating their Ashes, the Lye is evaporated, and the remaining dry Mass is an impure Fossil Alkali. *Kelp*, *Soda*, and *Barilla*, are of this Kind. The Reader who would consider this Subject farther, may consult *Maquer's Chemical Dictionary*; where he will find much Learning, familiarly delivered.

The common vegetable fixed Alkali, is obtained from the Ashes of any Plant, not marine, soaked in Water or lixiviated. That Lixivium, evaporated to Dryness, and the remaining Mass, is our Subject. Pot-Ash and Pearl-Ash, at least the American, are of this Kind: The last is the first purified; either by Calcination, or repeated Solution and Evaporation. Salt of Wormwood or Tartar are the best

Fixed Alkalis, to try Experiments with ; as they are purer than Pot-Ash, or Pearl-Ash.

All Alkaline Salts have the Property of running *per Deliquium*, or deliquiating ; that is, drawing so much Moisture out of the Air as to dissolve themselves and melt, or run away. The Fossil Alkali has not this Property to so great a Degree, as the vegetable fixed Alkali ; and it were to be wished, that Experiment had ascertained how far it might not, on this Account, form a better Basis to our Sugar than Lime or Pearl-Ash : The first is now generally used by the English ; the last, by the French.

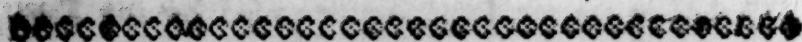
But to return to Neutral Salts. Neutral Salts are obtainable from the Matters they are found mixed with, by Solution and Evaporation. Solution is dissolving them in any convenient Liquid, generally Water, Evaporation is volatilising that Water, till it is expended ; in other Words, boiling it away. By this Method also, Salts are depurated or cleared from any accidental Foulness. If the Evaporation is gradual, and only carried to a certain Length, Neutral Salts chrySTALLISE : If the Evaporation is total and hasty, a saline Mass is obtained, generally in the Form of a coarse Powder, sometimes in that of a solid opaque Mass.

CHRYSTALLISATION is a Property that Neutral Salts have of shooting or running together, into pellucid Masses, called Chrystals. This depends on the Properties by which they are capable of Solution. A Substance is capable of Solution, or being dissolved, when the Liquid in which it is immersed, has the

the Power of insinuating itself between its Parts, and dividing them; and farther, the Power of suspending, in itself, the Parts so divided: Such a Liquor is then called a Solvent, or Menstruum. The last of these Terms is generally used where the Solvent is particular to the Substance in Question: for Instance, *Aqua Regia* is the only Liquid in which Gold is dissolvable. *Aqua Regia* then, alone, has an Affinity with Gold, and is its Menstruum. Now when, by Evaporation, so much of the Solvent is taken away, that there is not enough left to suspend and divide the Substance dissolved, those divided Parts necessarily come together again. In the Case of Solutions of Neutral Salts, when this is done gradually, and stopped at a certain Point, (by Laws of Attraction, not yet particularly understood) *these Salts* have a Power of so adapting their Particles to each other, as to assume a Shape peculiar each to itself: Thus, common Salt forms square Chrystals, and Nitre long six-sided Ones. Where the Evaporation is hasty and total, there is so strong a Circulation, or rather Agitation, of the Parts of the Solution, as to overcome the Attraction by which the Particles of Salt adapt themselves to each other; and when the Evaporation is finished, the Salt remains, either in the Form of a coarse Powder, or an opaque Lump. Evaporation is seldom so hasty, but that some small Chrystals are formed*.

Of

* Since the above was printed, I have been informed, by my learned and ingenious Friend, Dr. Pinckney, of Westmoreland, D. that



OF O I L S.

OILS are supposed to be compounded of Phlogiston (which we are to remember is Fire, in its fixed State) Water, Acid, and Earth. Oils have not Affinity enough with Water to unite with it, or with any other Fluid that abounds with it, *E. G.* Wine; the Phlogiston sheathing those Principles that have an aqueous Affinity. (*See the fourth Law of AFFINITIES before-mentioned.*)

Oils are of two Kinds; Gross and Essential.

Gross, sometimes called fat Oils, exist as a natural Juice in most Vegetables; in some they are so abundant, as to be obtained by Expression: Olive, Nut, and Seed Oils are of this Kind. The Properties of Gross Oils, worth the Notice of the Sugar-Maker are,

That Fire makes them empyreumatic. *Empyreuma* is that burnt and offensive Quality all fat Matters acquire from a naked Fire, and which generally gives them a black Colour:

That

that the Chrystallisation of many Neutral Salts will not succeed in this Climate. He observes, that every Neutral Salt chrystallises at a Degree of Heat peculiar to itself; generally somewhere about 50, on Farenheit's Thermometer. Common or Sea-Salt, (and perhaps some Others) requires no peculiar Degree of Heat; but will form its Chrystals, on simply stopping the Evaporation at the proper Point.

That they are too fixed, to be raised by any Fire used in his Business :

That they are specifically lighter than Water :

That they are imbibed by solar Earths, perhaps by all absorbent Earths : And, lastly, that by the Fifth Law of Affinity, they may be made to unite with Water, by the Medium of Mucilage, either vegetable or animal ; which Union may again be destroyed, by Quick-Lime and Alkali, whether volatile or fixed.

Essential Oils are the immediate Vehicles of the Smell and Flavor proper to Plants from which these Oils are always obtained by Distillation. Chemists have disputed about them. Their Properties worth our Notice here, are,

That their Smell and Flavor being evaporated, they become Resins :

That of themselves, or mixed with Water, they are so volatile as to rise with a Heat less than that of boiling Water ; but that when united with gross Oils, they adhere to them, and become considerably fixed :

That the Flavor of Rum is entirely owing to them,

 OF G U M S.

GUMS are divided into Mucilaginous and Resinous; the first are called simply Gums, and the last Resins. First, of Resins.

Resins are Oils united with a large Quantity of Acid, some Earth, and a very little Water, they dissolve in ardent Spirits and Oils, by Means of the Phlogiston in both, and have no Affinity with Water. All the Turpentine and most of the Balsams, when old, lose their fine essential Parts, and become Resins: The French call them Colophon, and some old English Chemists Colophony; it is true, they generally mean the Residuum, after distilling an Acid Spirit, Ætherial Oil and Balsam, from Turpentine.

Gums or Mucilages, as Gum-Arabic, Cherry Tree, Senegal, and Cashew Gums, are generally allowed to have the same Principles with Resins; but the different Proportions in Gums and Resins make them very different Substances; In Gums the Phlogiston is not in sufficient Quantity to sheath their elemental Acid and Water from common Water, in which they consequently dissolve; this the more freely, as they are purely mucilaginous Gums. Some Trees afford Substances called Gum-Resins, from their partaking of the Properties of both; consequently, these last dissolve in either Spirits or Water, according to their Affinities. Resins and Oils will unite, or at least mix very
intimately.

intimately with aqueous Fluids by the Intervention of Mucilages, which are a very abundant Component, where very little suspected: For Example, Wine and Vinegar, when bright and fine, we should not suppose to contain much of them; yet the Matter usually termed Ropiness, is nothing else. Mucilages are Gum dissolved; Gums are inspissated Mucilages: Now, an Alkali, or Quick-Lime, which always contains some Alkali, by neutralising and uniting with their acid Principle, separates it from the other Principles, and also the Oils or Resins from any aqueous Fluid, in which they might have been dissolved. I beg here to remark, that to get rid of the Mucilage in Cane Juice, is the great Difficulty in Sugar-making; as we shall see hereafter. This is generally effected by the Alkali or Lime used for Temper; Part of which, at the same Time, becomes the Basis of the Sugar. It has generally been supposed, the End proposed by these Substances was, to neutralise an Acid occasioned by some Indisposition in the Cane Juice. The Reader will see how far this is true, when we come to speak of the component Parts of the Sugar, and of the Juice of the Cane, as it comes from the Mill.

ABSORBENT EARTHS are such as will absorb and unite with Acid, and form a Neutral Salt. Limestones, Marles, Chalk, Magnesia, are of this Class. Absorbent Earths are, as already observed, the Bases of Alkaline Salts, and of all Neutral Salts, either mediately or immediately. Calcined by a violent Fire, they unite with and fix some of it, and become Lime.

E

LIME,

LIME, it seems to be generally agreed, is Earth calcined. Lime-stones and Marbles, are Earths hardened, by some petrifying Medium, into the Appearance of Stone. Rocks and Stones themselves, really vegetate, grow or increase, as Trees do. No One can doubt of this, who carefully examines some Sorts of them, when broken; since their Organization is as apparent, as that of the Parenchyma of an Apple or Pear, cut in Half.

The Calcination of Earths volatilises and dissipates all foreign Matters, and, as we have said, unites with them a certain Portion of Phlogiston: This is manifest, on Water being presented to a Lump of Lime; the Earth, having a greater Affinity with Water than with Fire, unites with the first, and quits the last. Fire while fixed, and a component Part of a Body, loses its Heat; because, its Parts do not any longer circulate within themselves: The Moment it is decomposed, as here, the Fire becomes elementary, and the Fluid regains its Heat, and escapes. No other Rationale can be given; for the Quantity of Fire is too great in Lime, in the Action of slaking, to be produced by Attrition; and the Union of elementary Fire with other Bodies, has been long proved, beyond a Doubt. Lime again calcined, loses Water, and imbibes Fire anew; and the oftener this Operation is repeated, the Lime is the purer; because, some foreign Matter is every Time carried off with the Water. Lime almost always contains Salt; but Salt is foreign to its Nature, and renders it impure, and particularly

ticularly unfit for making Sugar. I conceive the Salt in Lime is thus generated: To make Lime, a Stratum of Wood is laid at the Bottom of a Kiln; on this, a Stratum of Lime-stone; and so on to the Top, Stratum super Stratum. The Bottom is set on Fire, and the Whole burning together, the Wood is burned to Ashes, and the Stone converted into Lime. In the Beginning, a thick Smoke arises, which consists of all the most volatile Parts of the whole Mass: After burning for some Time, the less volatile. Of these, the Acid, disengaged from the oleaginous Parts of the Wood, and which is of the same Nature of that obtainable from Sulphur, is a considerable Part. Now this Acid, forced by so violent a Fire into the Stone, there exerts its Affinity, and forms, first, a Neutral Salt; which still farther urged, becomes alkaline, and is no longer volatile. On this Theory, I conceive, many of the Properties of Lime may be explained. Again, as different Sorts of Wood send up Acids differently combined, and some sooner, and others later in the Process; this Salt becomes very different, in different Specimens of Lime; indeed, the Lime itself will be different. From hence also may be inferred, the Reason why Chemists, of known Accuracy, have varied so exceedingly in their Accounts of the Salt of Lime.

Lime may be judged pure, when it is very white ---when, upon being wet in the Lump, the Heat diffuses suddenly and equally through the Whole---when, being thrown into Water, a white Cloud forms

forms all round it equally--and, lastly, when after being slaked and made into a Paste, it hardens soonest in the Air. I have been the longer on this Substance, on Account of its Importance in making Sugar.

BOLES, or BOLAR EARTHS, are a Species of Absorbent Earths; but differing, in some Respects, both from them, and from Clays: They have a Viscidity: The first has not, and have not the Tenacity of Clays; for, instead of being capable of moulding into regular Figures, which grow harder when dry, Boles crumble exceedingly when dry. Fuller's Earth, and the Boles of the Shops, known by the Name of *French, Armenian, and Bohemian* Boles, are the Substances here meant; most Clays have a Mixture of them. They are of the same Class with Marles; and, indeed. pure Marles would be the same Thing. The Property remarkable by the Planter, is their imbibing Oils. Fuller's Earth has long been in Use in the Clothing Trade, on that Account. They are, it must be admitted, to lie under one Inconveniency; which is, that when mixed with aqueous Fluids, they are so fine, as not to subside soon enough for the Planter's Purpose,

Of

WHITES OF EGGS.

THE *Whites of Eggs* are a very singular Substance, of many peculiar Properties. We have only to observe on One; which is, that with a moderate Addition of Heat to that of the Atmosphere, 20 or 30 Degrees for Instance, they become very fluid, and thin; but that with a Heat equal to 160 Degrees of *Farenheit's* Thermometer, they grow hard, and become opaque and white, from being colourless and transparent. From hence, they have long been in Use with the Confectioner, Cook, Vintner and Sugar-Refiner. When in their fluid State, they mix well with Gums, and the Oils the Gum has taken up, and entangle them, and, on the additional Heat, occasion a more perfect Separation of the Impurities, than can be obtained by the Medium of any other Substance, except the

SERUM of BLOOD, which has precisely the same Property, of first softening, and then growing hard: But as this Substance, while perfectly sweet, is not so easily separable from the *Crassamentum*, as the White of an Egg is from the Yolk, it is not used, where Eggs are in moderate Plenty.

E

SUGAR,



S U G A R.

BY this, as the *Nomen generalissimum*, we mean the best Sort of Sugar, or that from the Sugar-Cane. Sugar, in its general Sense, is a Saugarine, or sweet Substance, that manifestly exists in all Vegetables, in which the Taste can discover Sweetness, possibly, in all Vegetables whatsoever. From many it has been extracted; for Instance, the Maple, in North-America, which yields it in a Quantity sufficient for a Market. From the Parsnip, Carrot, young Corn, &c. it is obvious, that the Quantity obtainable would not pay the Expence of extracting it. I do not know that it exists in any animal or mineral Substance, unless Milk may be an Exception. The Sugar of Lead is Sugar itself, from the Vinegar (made, as we shall see presently, of Sugar) and the mineral Earth of Lead, which serves as its Basis.

SUGAR is a Substance *Sui generis*, and on that Account, some Chemists have denied, that it is a Salt: I do not recollect, that any Chemist has favored the World with an accurate Analysis of this Concrete. I conceive its Principles are first the same with every other Neutral Salt, which are an Acid, united with a Basis of Earth, or Alkaline Salt. A great Quantity

tity of Sugar is annually made on both these Bases. That with an alkaline Salt seldom stands the Sea: That with Lime is of a better Grain, and stands the Sea, but is apt to be of a worse Colour, and to cure but indifferently; add to which, if the Cane Juice had fermented, or by any other Means acquired any Sourness. The accidental Acid unites with the calcareous Earth of the Lime, and forms a subastringent bitter Salt, that spoils the Taste of the Sugar. To these two Principles, the Acids and its Bases, we are to add a considerable Quantity of Gum of the mucilagenous Kind, and some Oil. These Principles are essential to it: Besides which, it contains, as all Chrystals of Salts do, a large Quantity of Water: But this is not to be considered as one of its Principles: because, the Presence or Absence of Water occasions no Decomposition of the Sugar. Its Principles or component Parts then, are the vegetable Acid, on an earthy or alkaline Basis, Gum, and Oil.

IN Solution, Chrystallisation, and in the Manner in which its Acid unites with its Basis, it perfectly answers the Character of a Neutral Salt. Its Oil and Mucilage are the Principles which, united with the Others, make it a Substance *Sui generis*; which it is, on many Accounts.

FIRST, there is no Substance of the same Principles.

IN the next Place, it is the only Substance in Nature which ferments, and is consequently the Matter
of

of Wines and Vinegars. I speak here of Fermentation in its ordinary Sense; not of that which takes Place in animal, and possibly of mineral Matters.

I HAVE said, that Sugar is the only Substance that ferments, because no vegetable or other Matter will ferment, in which Sugar is not a Part. The more Sweetness is manifest in the Subject, the stronger Wine may be made from it; the Sweetness of Must, Wort, Stums, &c. not to speak of Melasses, prove this beyond a Doubt; add to this, that Wine may be made from Sugar and Water *alone*. It follows, that it is the Matter of ardent Spirits, alcohol Brandy, Rum, &c. for these are only procurable from Wines in a certain State. I have a great Doubt on this Question, what is the Basis of Sugar, when in its natural State? I mean, as it is found in some Kind of Raisins, and other dried Fruits, where the most careless Observer of Nature must have perceived it. I think it is an Earth; for Alkalis seem only the Creatures of Fire. I have seen no Canes in Jamaica so luxuriant as to exude a Juice rich enough in Sugar to chrystalise with the Sun's Heat. Ancient Writers mention such a Concrete. Some seem to confine this Observation to the Bambu, or Bamboo-Cane.

THE Chrystals of Sugar are known by the Name of Sugar-Candy.

THE saline Mass obtained from the Cane Juice by hasty and almost total Evaporation, mentioned in
our

our Account of Chryftallifation, is known by the Name of Moscovado-Sugar, by some Raw Sugar. This is of the best Quality.

WHEN it is of the largest Grain, *i. e.* when the irregular Chryftals are of the largest Size, obtainable in the Process of hasty and almost total Evaporation, the Chryftals are then hard and brittle.

WHEN the Chryftals are transparent, and the general Colour nearest to white. To which may be added, that its Colours are valuable in the following Order; always chusing light Shades, of a bad Colour, to dark Ones, of a better Colour; white, Straw or Lemon Colour, brown, red and black:

THAT it cures easily:

THAT it has no ill Taste.

LOAF or refined Sugar, is Moscovado Sugar refined, and the superfluous Water dried out of it, by baking, in conical Pots of earthen Ware; from whence, the Shape of a Loaf of Sugar.

MELASSES or Treacle, is the gross Oil of the Cane, a Portion of the essential Oil, some Gum, and a large Quantity of Sugar entangled in the Rest. The Oils in Treacle are always considerably empyreumatic. Rum made of Treacle more than ordinarily empyreumatic smells very disagreeably, and is of less Value than a Spirit free from this Accident.

G

It

It has already been observed, that Sugar, and all other Neutral Salts, are obtainable by Solution and Evaporation; but it will often happen, that a Solution contains foreign Matter, that is, any other Substance besides the Salt. The Cane-Juice from the Mill is of this Sort; for it is a natural Solution of the Salt of the Cane, in the Phlegm or watery Parts of that Plant, which has many foreign Matters or Impurities in it, as it comes from the Mill. What they are, will be shewn presently. But I must first observe to my Reader, that to separate Impurities or foreign Matter from Solutions, is the Object of Depuration.

DEPURATION is effected by sundry chemical Processes, adapted to the Nature of the Solutions to be clarified: From the Chemists, the Vintner, Apothecary, Confectioner, &c. have introduced many of them into common Life. These Processes are as various as the Solutions to which they are applied. The Principles on which they are grounded may nevertheless be reduced to five; which are, Colature, Decantation, Despumation, Ebullition, and Precipitation. The last three of these are more commonly called Clarification.

COLATURE or Straining sufficiently explains itself. This Process is only proper where there is no Affinity between the Subject and the Impurities; and where the Impurities are gross enough to pass the Philter. However simple this Process may appear,
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it is often a very difficult One; where the Subject corrodes the Philters, in common Use.

DECANTATION is simply suffering the Impurities to subside, and then decanting the Liquor. This is the best Process for fining Wines, where the Liquor is sound. The Objection to it is, that it requires Time.

DESPUMATION is performed by adding to the Subject *some Substance* which has a greater Affinity to the Impurities, than they have with the Subject. This Substance, by the last Law of Affinities, unites with the Impurities. It is farther required, that when the added Substance and the Impurities have formed a new Substance, it should be specifically lighter than the Subject, and consequently rise to the Top; when it is called Spume or Scum, and is to be taken off by skimming. This Process seldom succeeds, without the Addition of Heat. Heat alone, in some Cases, will do. Honey is directed to be clarified, by skimming over a gentle Fire, without any Addition.

EBULLITION is the same Process with the foregoing, except that the Subject is to boil, during the Clarification.

PRECIPITATION is performed by adding *some Substance*, as in Despumation, that will unite with the Impurities, and form a new Substance, that shall not have Affinity enough, even to mix with the Subject.

ject : But here the new Substance is required to be specifically heavier than the pure Subject, and consequently precipitate, or sink to the Bottom of the Vessel. The clear Subject is then obtained pure, by decanting, craning off the Cock, or any other commodious Method.

THIS "*some Substance*," we have spoken of in the Processes of Despumation and Precipitation, the Planters call Temper; and the using it, tempering the Liquor.

WE are now to consider the Impurities in the Cane-Juice. They are, all the Matters not necessary for the Formation of Sugar. I say this, because a Part of the Mucilage, and a Portion of the gross Oil, are necessary to constitute the Substance called Sugar; but the redundant Oil and Mucilage, are Impurities. I shall now give the Reader as just an Idea as I can of the Cane-Juice, and its Contents, both natural and adventitious.

THE Juice then, from the Mill, ordinarily contains eight Parts of pure Water, one Part of Sugar, and one Part made up of gross Oil and mucilaginous Gum, with a Portion of essential Oil. The Proportions are taken at a Medium; for some Juice has been so rich, as to make a Hogshead of Sugar from 1300 Gallons; and some so poor, as to require three Times that Quantity. By a Hogshead, I mean sixteen Cwt. The richer the Juice is, the more
free

free it is found from redundant Oil and Gum; so that, an exact Analysis of any one Quantity of Juice, would convey very little Knowledge of the Contents of any other Quantity.

THE above component Parts are natural to, and are found in all Cane-Juice. Besides these, the following Matters are usually contained in it: Some of the Bands or green Tops of the Cane, are generally ground in, and yield a raw acid Juice, exceedingly disposed to ferment and sour the whole Liquor: Some Pieces of the Trash or ligneous Part of the Cane: Some Dirt: And, lastly, a Substance of some Importance, which, as it has no Name, I will call the Crust. The Crust is a thin, black Coat of Matter, that surrounds the Cane between the Joints, beginning at each Joint, and gradually growing thinner, the farther from the Joint upwards, 'till the upper Part, between the Joints, appears entirely free from it, and resumes its bright yellow Colour. It may, where thick enough, be scaled off by the Point of a Penknife, and the Rind of the Cane will be left clean. It is a fine black Powder, that mixes with the clammy Exudations perspired from the Cane, and is most probably produced by Animalculæ: But whether from their Eggs, Fœces or Bodies, I do not conjecture. As the Fairness of Sugar, is one of the Marks of its Goodness, a small Quantity of such a Substance, must considerably prejudice the Commodity.

H

HAVING

HAVING laid before the Reader, such of the Doctrines of Chemistry, and the Rationalia of such of its Processes as relate to our Subject, and given him a chemical View of such Substances as he will find it necessary to understand the Nature and general Properties of; I will now lay before him the Process for making Moscovado Sugar, ordinarily used in the English Sugar-Colonies; that he may, with more Facility, compare it with that which it is the Design of this little Essay to recommend.

THE Process now used is, chemically Speaking, depurating Cane-Juice, by Colature and Despumation, and obtaining the Sugar it contains by Evaporation.

It is thus conducted: The Juice or Liquor runs from the Mill to the Boiling-House, by Means of a wooden Channel: When it arrives at the Boiling-House, it falls into a Vessel called the Receiver. It here undergoes the Process of Colature, by four or five Strainers, that in most Boiling-Houses divide the Receiver. Colature is here of little Service; for the Liquor is in general too much loaded with Mucilage to pass a fine Strainer; and a coarse One can be of no farther Use, than to detain the Trash, and some of the Scum formed by the Mucilage; both which would instantly rise to the Top in the Clarifyer. From the Receiver, the Liquor is conveyed to the Clarifyer. This is a large Vessel of Copper, called, by the Negroes, the Grandy Copper; and is capable of holding from two to five hundred Gallons.

ions. The Clarifyer is either placed in the Middle, or at one End of the Boiling-House. If at one End, a Copper, called the Taich, is at the other, and two or three Coppers are ranged between them. The Taich is ordinarily about one Fourth as large as the Clarifyer; and the Coppers, between the Clarifyer and Taich, diminish from the first to the last. Where the Clarifyer is in the Middle, it is either very large, or, as is most general, there are two, with two Taiches, one at each End of the Boiling-House: These are, in Effect, double Boiling-Houses.

WHEN the Liquor is in the Clarifyer, in Proportion to its Goodness, more or less White Lime, in Powder, is stirred into it. In moderately good Liquor, such, for Example, as produces a Hoghead and a Half per Acre; a Pint is thought sufficient for 100 Gallons. The Liquor is then made to boil immediately. A Scum is now thrown up; which, I conceive, is formed of the Mucilage, or gummy Matter of the Cane, with some of the Oil, and such Impurities as the Mucilage is capable of entangling. As this Scum rises, it is continually skimmed off, and the Liquor grows finer, and somewhat thicker. This is continued, 'till, from the Skimming and Evaporation, the Subject is sufficiently reduced in Quantity to be contained in the next Copper, into which it is then laded. In the second Copper, the boiling and skimming are continued; and if the Subject is not so clean as is expected, Lime-Water is thrown into it. This Addition is not only calculated to give it farther Temper, but
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to dilute it, and by that Means disengage the Impurities from the Subject, now considerably thickened. Pure Water would in most Cases answer better. Where the Liquor in the second Copper does not assume a good Appearance, for two or three Skips together, I conceive, that 20 or 30 Gallons of pure Water is the first Addition to be tried, if not the best; as it will generally be found that the Liquor has thickened too fast, to permit the Fæculencies to run together or attract each other, and rise in the Scum. It is obvious, that two Particles that have only a slight Attraction, may have that Attraction overcome, by the Resistance of a thick Medium, which would have brought them together in a thin One; and by this Time my Reader perceives, that Affinity is only a Mode of Attraction peculiar to Bodies in Solution, and of which we have given him the principal Canons. Liquor is said to have a good Appearance in the second Copper, when the Froth in boiling arises in large Bubbles, and is but little discoloured, it is then said, *to have a good Bead*. When the Liquor is, from Skimming and Evaporation, again sufficiently reduced to be contained in the next Copper, it is laded into it, and so on into the Taich. It is to be observed, that the Heat is in the Clarifyer about 230, and as gradually increased to the Taich, where it is about 400. I say this by Guess, as I had only the Pocket Thermometer of *Farenheit*, which is graduated no higher than 212, the Heat of Water boiling*.

* It were to be wished, that some Standard was universally known and assented to, by Philosophers of all Nations, by which the Quantum

In the Taich, the Subject is still farther evaporated, 'till it is judged fit to skip, or, as it is in some Places called, to strike. Striking or Skipping, is lading the Liquor, now exceedingly thick, into the Cooler.

of Heat might be expressed and understood by Figures simply, without referring to any particular Thermometer. A short Account of this Instrument will explain my Meaning, and I hope will not be thought foreign to our Subject.

This Instrument was first designed only to mark the Heat of the Atmosphere, and was contrived on this Principle: That all Fluids are considerably expanded and condensed by Heat and Cold. Therefore, if to a Tube of Glass, a hollow Ball or Globe of the same Substance was adapted, and this Ball and Part of the Tube filled with any Fluid; it was obvious, that as a greater Heat was applied to the Ball, the Fluid must rise higher in the Tube. Spirits of Wine, as the Liquor most susceptible of Expansion, was the Fluid first used, generally with the Addition of some colouring Drug, as Cochineal.

This Instrument was soon applied to Chemistry; but was, at first, of little Use, as the Spirit expanded too freely, when applied to any considerable Degree of Heat, to be contained in a Tube of any convenient Length. Sir Isaac Newton then contrived a Thermometer, in which the Fluid was Linseed Oil. This Thermometer was long considered as a Standard, and supposed to be the best; although the Objections to it were not unknown in his Time.

Fahrenheit afterwards changed the Fluid to Quicksilver. Reaumur and some Others have invented and improved on Thermometers; but the Misfortune is, that every One has, in their Writings, conceived, that their Readers would know all this; and when they speak of a Degree of Heat in Figures, instantly apply it to the Thermometer they mean. How few are there that know that 210 on the Pocket Thermometer, and 37 on Sir Isaac Newton's, express the same Degree of Heat; namely, that at which Water begins to boil. A Thermometer expressly contrived for the Sugar-Boiler, would be a valuable Acquisition to the Planter.

THE Cooler is a large square wooden Vessel, about 18 Inches deep, and as large as the Floor of the Boiling-House will permit. Here the Subject cools, and the Sugar grains; that is, runs into a coarse irregular Mass, of imperfect and semi-formed chrystals, such as we have described all Salts to run into, when the Fluids they were dissolved are hastily and totally evaporated. This Mass, which, as we have said before, is the Moscovado Sugar, contains at least its own Weight of Melasses. From the Cooler it is carried to the Curing-House, where the Melasses is separated from it.

BEFORE we follow it into the Curing-House, we are to observe, that few Planters agree in any Rules for judging when the Subject is sufficiently evaporated to strike, or skip from the Taich to the Cooler. It is certain, the Negro-Boilers have no Rule at all, and guess by the Appearance of the Liquor; and indeed it is wonderful, what long Experience will do.

COLONEL Martin of Antigua, in his Essay on Planting, has given Rules for judging by the Touch: He himself observes it to be exceedingly painful; and it is demonstrably less certain, than the Method most commonly used, which is, by the Ladle. The Way is to take a small Quantity of the Subject in the Boiling-House Ladle, and pour it gently into the Taich. The Stream from the Ladle, when the Quantity is nearly exhausted, breaks. If that Part of the Stream next the Ladle, suddenly contracts, and flies up to it, the Subject is thought sufficient-

ly

ly boiled. Two Circumstances render this more certain than the Touch, between the Forefinger and Thumb. First, the Subject is always at or very near the same Heat; the Time it has to cool between the Emerfion of the Ladle from the Taich, and the Break, being nearly the same: And it should be remembered, that the same Quantity should always be taken up, and the Ladle raised as near the same Height as possible. These Circumstances, I have always observed old Negro Boilers attend to mechanically. Now, in the Method by the Touch, numberless Circumstances will unavoidably vary the Time; consequently, the Heat, at the Instant the Thread drawn between the Finger and Thumb breaks; and, with the Time and Heat, the Evaporation, while the ~~Ladle~~ is in the Air. The other is, that so small a Quantity is taken between the Finger and Thumb, that the Temperature of the Boiler's Hand, will affect the Experiment. If the Perspiration is very strong, the Quantity of Moisture will be sufficient to destroy the Experiment absolutely. It is said, that a Gentleman of *St. James* in this Island judges by the Thermometer. If he does, I conceive the Rationale of his Method to be this:

WATER will not retain above 230 Degrees of Heat. Salt thrown into it, makes the whole Body more dense, and approaching the Nature of a solid Substance. Oil, being more viscid or tenacious than Water, will bear also a greater Heat; and Gum is a solid Body. Now, because a solid Body will bear a certain Degree of Heat beyond any liquid Body; it follows,

x Subject

follows, that the Heat and Density will be proportionate: But as the watery Parts of the Cane-Juice evaporate, the Remainder has a greater Proportion of Oil, Salt and Gum, to the Water, not yet evaporated. When the Evaporation is carried on so far as the Point which is most advantageous to skip; the Subject, from these Principles, must necessarily have acquired a precise Degree of Heat, which becomes this Gentleman's Standard. The same Gentleman is said to be possessed of some other Secrets, which he does not think fit to communicate. I will venture to promise any One, who will make a Set of Experiments, with Care and Attention, in the Manner he will find proposed in the last Pages of this Essay, nothing worth knowing on this Subject will be long a Secret to him.

I SHOULD have reserved the Method I would recommend to judge of the Time for striking, 'till I came to the Process I propose, but that the Reader may have the Whole of the Matter together, I will insert it here. Provide a small thin Pane of clear crown Glass, set in a Frame, which I would call a Tryer; on this drop two or three Drops of the Subject, one on the other, and carry your Tryer out of the Boiling-House into the Air. Observe your Subject, and more particularly, whether it grains freely, and whether a small Edge of Melasses separates at the Bottom. I am well satisfied, that a little Experience will enable you to judge what Appearance the whole Skip will put on when COLD, by this Specimen, which is also COLD. Add, that your
Boiler

Boiler may now touch and examine the grain between his Fingers. I recommend glass rather than a Plate or a Dutch Tile because it is transparent and the Boiler may form some judgment by holding it up to the Light. This method is used by Chemists to try evaporated Solutions of all other Salts, it may seem therefore somewhat strange it has not been long adopted in the Boiling House. But to proceed,

We are now to go on where we left off in describing the present Process for making Moscovado Sugar, which was at it's being carried to the Curing House.

THE Curing House is a large Building that is, or should be open on all Sides to let in the Air. The Pit or Bottom of it is lined with Terras and consists of two Sides, or Slopes, from the Sides downwards to the Middle. In this Pit the Melasses is collected. At about 8 Feet from the Pit there is a frame of Joistwork without boarding. On the Joists of this Frame, Empty Hogheads without Headings, are ranged. In the Bottoms of these Hogheads 8 or 10 Holes are Bored, through each of which the Stalk of a Plantain leaf is thrust 6 or 8 Inches below the Joists, and is long enough to stand upright above the top of the Hoghead. Into these Hogheads, the raw Sugar from the Cooler is put, and the Melasses drains through the Spungy Stalk of the Plantain Leaf, and drops into the Pit. The Sugar is then said to be Cured, and the Process is finished.

THE above Process is little varied from in Practice.

K

Some

Some very few Planters instead of Boiling, as soon as the Juice is in the Clarifyer keep it at a Simmering Heat (about 160) for an Hour, but it is not insisted on, even by those who feel the advantage arising from it. Some Clarify with fixed Alkaline Salts; the French universally do this, but as Sugar formed on a Basis of fixed Alkaline Salts never stands the Sea, this ought to be prohibited the Boiling House; without some Earth is joined with it. Such Earth as approached nearest to that which is the Basis of Allum would perhaps be most proper, could a white Marle or a Bole of that colour be procured, these and Tobacco pipe Clay would be well worth trying: as Sugars on an Alkaline Basis are generally as much superior in their colour as those on Lime are in their Grain, how far a judicious mixture of Alkaline Salts and Lime might prove a better Temper than either Lime or Alkaline Salts alone, is an enquiry that ought to be pursued.

SOME Planters use vegetable Juices, those most commonly tried, are, the Juices of the Cashew, Pomegranate Peel, Dumb Cane and the Ochra. The first are strong Astringents; and the last is Mucilaginous. They have lost their reputation; and generally speaking deservedly, but the use of them in particular cases, may merit the attention of the judicious Planter.

CLAYED SUGAR does not strictly belong to our Plan. It may not, however be amiss to give a general Idea of the Process.

MOSCAVADO;

MOSCADO; and sometimes the Sugar from the Cooler is put into Conical Pots with the Points downwards, which have a Hole about half an Inch in Diameter for the Melasses to drain through, and on the broad part now the Top, a stratum of moist Clay is laid on the Sugar. The Theory then is this. The Water from the Clay unites with the Melasses and dilutes it, consequently more of it comes away than from Sugar cured in the Hoghead. As the colour of Moscado Sugar is solely owing to the Melasses remaining in it: the Sugar after claying is left so much whiter and purer as to be almost double the value of common Moscado Sugar. The Reasons why this Process is not universally adopted are, first the tediousness of the Process; which if the Curing House was somewhat differently constructed, would cease to be an objection: and Secondly, because the same water that dilutes and carries away the Melasses dissolves and carries away so much of the Sugar with it, that the Difference in Price, in the opinion of most Planters, does not pay for the difference in quantity.

In the common Process it is obvious that only such Impurities as are specifically lighter than the Liquor can be separated from it by the Despumation and Ebullition. The Crust is by no means got clean out of it by this Process, on the contrary, it is commonly visible in small black Specks, which are generally mistaken for dirt, both in the Liquor and in the Sugar. Of this no one can doubt who will be at the trouble

trouble of examining either carefully. The Crust is most easily to be distinguished in a thin Plate of Pan Sugar held to the Sun. Again, the Violence of the Fire, where the Boiling is so easily in the Process, possibly unites the Heterogeneous Particles in the Syrop, that were but loosely connected in the raw Liquor, add to which, that where the Liquor boils violently, the whole Body of it circulates with such Force as to carry down again the very Impurities that had come to the Surface, and with a less Violent Heat would have staid there. I have already mentioned the Inconveniencies attending the Liquor being thickned by early and hasty boiling before the Impurities had run together. A Heat at about 160 Degrees of Farenheit's Thermometer for the first Hour would be an improvement in this Process: But what ought for ever to banish it, is the following consideration, that Clarifying in the common method by Despumation and Ebullition the most careful Negroe Boilers, skim away from a 6th to a 4th of the subject, and some careless one's HALF of it. It is true these plentiful skimmings are sent on to the Still House. But the Planter would find a great Difference between the Profits arising from making Sugar of ALL his Liquor, and Rum of ALL his Liquor. It follows then, that in whatever Proportion, that of which Sugar might be made is converted to Rum, he is a Loser in precisely the same Ratio.

I SHALL now propose a Process free from the above Objections, As that in common Use is Clarifying the Juice by Despumation and Ebullition, and obtaining

ing the Sugar by Evaporation; This is to clarify by Despumation and Precipitation; and to obtain the Sugar by Evaporation.

THIS Process cannot be advantageously carried into Execution, without an additional Building to the Works to be called a CLARIFYING-HOUSE: which I must beg the Reader to suppose. In this Clarifying-House there must be so many Coppers of 500 Gallons each, as the size of the Estate requires; three will be sufficient for one of 100 Hogheads. Let each of these have a sepearte small Fire Place, and sepearte Brick-work that it may cool the sooner. To the Fire Place let there be a Door, that will cover the Ash-Hole and Grate; by Shutting which, the Fire will go out for want of Air. These Coppers should be so contrived, that the Liquor when Clarified, may be drawn off, either by a * Siphon or Crane, or by a Cock, into a Channel; which is to conduct it to the Receiver in the Boiling-House; which must hold at least 600 Gallons. If you have not FALL enough, a Pump must Supply that Defect.

Although no alteration in the Boiling House is absolutely necessary; the Planter would find a great Advantage in having all his Coppers of the same Size: the most commodious on the whole would be

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* The Ingenious Mr. Reeder of Morant Bay, has Invented a Siphon or Crane expressly adapted to these Clarifiers. He communicated the Invention to me in a very short Time, after I explained to him my Idea of a set of Works. It is exceedingly ingenious, and shows a Considerable Knowledge in Hydraulics and Pneumatics.

from 100 to 150 Gallons, but of the same Diameter with those now in Use of 300 Gallons; for as the Business of the Boiling House rightly understood is simply Evaporation, the SURFACE should be wide, but the Depth not to exceed two Feet: At the same Time, there are Objections to having them so Shallow as to make them rather Pans than Coppers; for fear of Burning, not only the Sugar, but the Vessel. The Coppers in the Boiling House should have a Groove from the one to the other, so contrived, that when one is full, the Liquor may run over to the next without the Labour of Lading from one to the other. I have only to add: That when in describing this Process I speak of a Clarifyer: I mean one of the Coppers in the Clarifying-House: And that when I speak of a first Copper, I mean that now called the Grandy Copper, or first from the Receiver: And that dropping the Word TAICH, I call it the last Copper.

THESE things being premised, I would have the Process thus conducted.

INTO the first Clarifyer put four Gallons of common Water, and one of strong lime Water. Let the Stream from the Mill be turned into it, and light the Fire. While the Liquor is filling the Clarifyer, beat the whites of 25 Eggs with some of the Liquor put in by little and little; two Quarts may suffice: When the Clarifyer is near full, Stir this well in. Then take five Pints of the best white Lime and as many Gallons of water, mix them well together, stir these well in, a stout Negroe agitating the Liquor with the Boiling House

Houfe Ladle, and another putting in a Quart at a Time. Let the Heat of the Liquor be now raised to 140 Degrees of the Common Pocket Thermometer, let this Heat be continued one Hour. Skim it carefully. To five Gallons of Water put ten Ounces of white Marle, Tobacco Pipe Clay, or other white Bol- lar Earth: if you have not any of these, ten Ounces of Fuller's Earth. Let it be previously powdered, and well mixed with the Water. Stir this in as the Lime and Water were directed to be; increase the Heat to 160. Continue it half an Hour.---Skim. --Increase your Heat to 190. Continue it half an Hour.---Skim. Increase the Fire to 200, and shut the Door of your Fire place, which puts it out. Let your Liquor remain four Hours undisturbed, and then draw it off into the Receiver: if your Process succeeds your Liquor will be as bright as Madeira Wine.

I should observe that when you have done filling one Clarifyer you go on to the next, repeating the same Process. From the Receiver your Liquor is to be conducted into the first Copper. For fear of burning, you may throw a Gallon into each Copper hung to the same Fire, but after let your Liquor run into the first Copper: when full, by means of the Groove it will fill the second; and so on to the last Copper; when all are full let a small stream run into the first Copper just sufficient to equal the Evapora- tion and keep them all full. By this Management as the first Copper receives the fresh Liquor, it's Con- tents will be constantly diluted; the Contents of the second will be more dilute than those of the third, and so on to the last Copper; where the Liquor will
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be least diluted, and consequently will be fit to strike first. You now examine the Subject by your Tryer as directed above; and when fit to Skip you draw off half the Contents of the Copper by Lading it into the Cooler in the Common way. You then increase the Stream from the Receiver into the first Copper till they are all full again, and so continue the small Stream to keep them full as before; till the Liquor in the last Copper is again fit to Skip. The rest of the Process as to Curing, &c. as in the old way.

THE Reader perceives two Essential Differences between this Process: And that in Use.

The first and most material is: Letting such Impurities as the Skimmer could not separate from the Liquor be precipitated by the four Hours Rest. Secondly, Finishing and completely Clarifying before you begin to Boil: and I must repeat; that Clarifying or the Purification of the Liquor from all foul and adventitious Matter; and Boiling, or the Simple Evaporation of the Aqueous Parts of your Solution, should ever be considered as two distinct Operations or Processes.

THE other Differences. The * Eggs, Solar Earth, the Constant Dilution by so large a Quantity of Water

*Eggs * might be raised on the Estate: if bought at 8 for a Bitt from a Dollar to 10 Shillings, would Clarify Liquor for a Hoghead.*

Water being directed to be added to the Temper, are not absolutely necessary: But upon a calculation of Expence, Time, &c. which I have made, and which every Gentleman may make from his own Data, will be found worth a strict Attention: The two following he may assure himself are just, viz,

That he will make from fifteen to thirty per Cent more Sugar, from a given Quantity of Liquor, and,

That his Sugar will be from four to ten Shillings a Hundred better in Quality,

The first of these is taken from the Difference in the Manner of Skimming, by which he will make about ten per Cent less in Rum, but that will be finer. The last from an Experiment, I made myself, at an Estate in Westmorland, where under many disadvantages, the Sugar was by good Judges esteemed five Shillings per Hundred better, than that made the Skips before and after. * It must be confessed that in a second Experiment I tried at Hope Estate in Liguanea, the Sugar was neither better, or worse; the Process failed, from these Circumstances, viz. I had no Thermometer, which I had in Westmorland. The Copper was so hung that the Fire, (if I had had a Thermometer) was ungovernable, on account of a Door, which if open, made the Fire rage so, that the Liquor boiled before

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* The Earth I used was a Clayey Marle of the Colour of Fuller's Earth, which I found on Fontabelle Estate.

I thought it was within 30 Degrees: and if the Door was shut, the Fire would not burn at all. Perhaps the true Reason was; I attempted to make two Ounces of Isinglass, supply half the Quantity of Eggs. Besides all this, it is not impossible that one of the Boilers squeezed a Lime in the Copper; which will I conceive, spoil either the old or new Process; if done before Skimming. However, I have in both the Experiments, laid the whole truth before the Reader, that he may judge for himself. It were to be wished this Process, had in the present Boiling Houses, a fair Tryal. The only Difficulty is, after the Liquor is Clarified in the Grandy Copper, getting it out, without disturbing the Sediment. I used the Still-House Crane as long as it would run, and the Ladle cautiously for the rest. A few Skips of Sugar made this way: with the Negroes well watched, that no Tricks may be played; would I believe, evince the Necessity of Precipitation.

THE same or rather a less Number of Negroes, would serve the Clarifying House and Boiling House; that now attend the Boiling House alone: For, one to each last Copper, and one to the Stream, and no more will be wanted in the largest Boiling House; and on small Estates, one Negro alone, could attend the Boiling House. Three Negroes would be found enough for the Clarifying House. Add, that the Labour of standing to the Skimming is taken away: so that the Negroes would not be so hard worked as at present.

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I have now gone through the whole of what I proposed: I have treated the Subject, on a Supposition that the Cane Juice was always the same. I did not promise the Reader any Rules for amending defective Liquor, either from Rat-eaten, blasted, or fermented Canes; but I hope I have done more. I have endeavoured to enable him to find methods of Curing such Defects from his own Funds of Chemical Knowledge, in which I wish him Success.

BEFORE I take my Leave of him, I would recommend to his serious Consideration the Use of what I would call an Assay Kettle and Cooler. By the first; I mean, a Tin or Copper Vessel to contain six Quarts; marked by Lines on the Inside, at every Pint; by the Second; a Flat Tin Vessel, like the Common Dripping Pan. If his Liquor proves Refractory, let him put a Gallon of it into his Assay Kettle: and try what Additions by way of Temper, best dispose it to Settle and Clarify. If it is too Acid, a Solution of Pearl Ash will occur to him; if too abundant in Oil, he may be assisted by Mucilages, as Ochra, &c. If already too Gummy, some Blood or whites of Eggs may be tried: and so of the rest, and when he succeeds in small: common Arithmetic will tell him the quantities to be used in his Clarifiers. Besides this Use of his Assay Kettle, he may make Experiments with it, to ascertain the Effects such Substances as he has read, or heard of, will have on the Liquor, in its different States; always carefully marking the Heat by a Thermometer; and also noting the Quantity his Liquor wasted, swelled, required to be diluted by,

by, &c. and lastly, what Quantity of Sugar a Gallon of his Liquor yields.

THE Substances I would particularly recommend for these Experiments are,

FOSSIL ALKALI. See Page 12.

MIXTURES of different Alkalis with Lime, and in different proportions,

VOLATILE Alkalis at first, and Lime when the Liquor was despumated.

LIME Slaked and unslaked, and these in different proportions,

POMEGRANATE, Dumb Cane, and the Cashew unripe.

OCHRA, Gum Senegal, or any other cheap Mucilage.

MARLES and Boles, These should be the whitest or lightest coloured that can be procured, from England. See Page 20.

TOBACCO pipe Clay, and the Clays and Earths in the Neighbourhood of the Estate.

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THE BONES, and Horns of Animals, calcined and Powdered.

BUTTER, just before Striking. N. B. This Hint I take from BROWNRIGO.

AND LASTLY, Yolks and Whites of Eggs, Serum of Blood, the Crassamentum of Blood: and these substances seperately and mixed.

THE Effects of some of these, particularly Volatile Alkalis, have not been tried; and of those which are most known, the time of using them, the degrees of Heat, and many other Circumstances, necessary to be attended to, are not universally agreed on. The Importance of a more general skill in the art of making Sugar, at this particular period: when the prices of Sugars in Europe are lower by THIRTY PER CENT: than they were three years ago; must be sufficiently apparent. That general skill can (I conceive) be acquired by EXPERIMENTS alone.

The Books I have chiefly consulted and which are my authorities, are; Maquer's Chemistry Vol. I. Shaw's Lectures: and the Chemical Parts of Lewis's Dispensatory. These will be found worth the attention of such gentlemen as wish to acquire a general Knowledge of Chemistry. Some of my Observations on Earths, were suggested by Van Swieten's Comment on Boerhaave Vol. I. Pag. 40.

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I have only to add that any Communications, to the Author, founded on Experiment: will be considered as an Honor to himself; and may possibly be hereafter, useful to the Public.

F I N I S.